Thermoset resins hit hard by sagging economy

Renewed drop in demand for durable goods has translated into increased sales losses for phenolic, unsaturated polyester, epoxy producers

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The major thermosetting resins—epoxy, phenolic, and unsaturated polyester—are headed toward the depths of the second trough of the current double-dip recession. Tied as they are to highly cyclical durable goods markets and the construction and auto industries, these resins have had to suffer through two attempts to bring inflation under control in a way that many other products and industries managed to avoid.

Hardest hit are phenolics, 87% of whose volume goes for bonding and adhesives in such products as laminates, insulation, plywood and fiber board, foundry molds, and rubber. Phenolics sales in 1982 may be half the all-time high of 1.74 billion lb in 1979. Polyesters, three quarters of which go into construction, transportation, and boats, fared a little better. After a loss of 25% from a record 1.25 billion lb per year set in mid-1979, polyesters made a partial recovery after mid-1981. Renewed losses may result in 1982 polyester sales that are 30% below those in 1979.

Epoxies always are an exception among the major thermosets. Their broad applications base and high-performance character make them relatively resistant to economic cycles. Epoxies continue selling strongly well into every recession. They command relatively high prices and profits throughout. Epoxies have a vigorous export market. Their only disadvantage is that the high-technology markets where they find use usually rise late in an economic recovery. Epoxies hit a record 337 million lb-per-year sales level after the beginning of 1980, lost only 7% of this by the end of that year in the first downturn, then went on to hit a new high of 340 million lb per year before the end of 1981. This year epoxy sales will be down, but for 1982, losses in this second slump may be limited to less than 10%.

Key Polymers

The reason for the strange behavior of thermosetting resins lies in the nature of the economic climate of the past three years. High rates of inflation and interest in that time sharply increased the prices of durable goods and of the loans needed to buy them. These factors had a heavier impact on such industries as construction, autos, and boats, where thermosets find most of their uses, than on other industries.

Inflation rose to 11% in 1979, with a spurt to 18% in the second quarter, hovered between 12 and 15% during 1980, then slowly subsided to present levels of 6%. Interest rates also took off in mid-1979. The prime rate, the rate banks normally charge their most favored customers, rose to 11% then, peaked at 20% in the spring of 1980, subsided to 11% that summer, then rose in excursions above 20% that lasted through the end of 1981. Fall-offs in the prime rate have been steep this month, and at press time the rate was 13%.

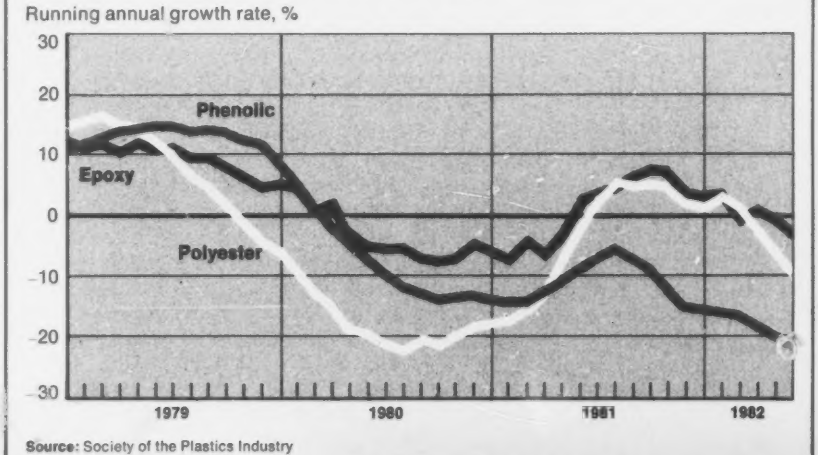
Thermosetting resins benefited from a temporary rise in business confidence and consumer spending in the first part of 1981. People thought that the coming tax cut and military spending increases would stimulate the economy, that decreased government spending would bring down inflation, and that lower inflation would deflate interest rates. These hopes evaporated over the summer.

A tight money policy of the Federal Reserve System combined with business demand for credit to keep interest rates up. Expectations that lower tax revenues from lower incomes and profits would raise the federal deficit also served to keep interest rates at high levels, because investors expected the government to increase its own borrowing. Auto sales resumed their slump with the end of rebates by car manufacturers.

Thus, total sales of the three largest-volume thermosets have been careening down hill for the past two years, with a pause for rest in the middle.

Thermoset resins are unlikely to recover truly from this most recent downturn until the beginning of 1984. This is because this new phase of the recession is a broader, more deeply set one, from which recovery cannot begin until sometime in 1983. The history of thermosets is that they have a flat year after the end of a recession. Unemployment was about

Thermosets suffer double-dip recession



Source: Society of the Plastics Industry

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5.5% in 1979 and rose above 7.5% in 1980 during the first downturn. Now unemployment is almost 10% as the recession has spread from construction and durable goods, through the industries that serve them, to other parts of the economy.

There is still a rough road ahead. Interest rates have declined to 13%, but this is still too high. Rates have come down this far, this fast, because of reduced business investment and demand for consumer credit, and because of expectations that Congress and the Reagan Administration can minimize federal deficits. If these latter expectations are not fulfilled, rates may rise again. The tax hike needed to trim deficits will not stimulate the economy. A key figure to watch in estimating the fortunes of thermoset resins is autumn sales of 1983 model cars.

Domestic sales of new U.S.-produced autos—a big user of thermosets—were down 8% to 8.4 million autos in 1979. Sales lost another 24% to 6.4 million in 1980, followed by a 3% fall to 6.2 million in 1981. Imported car sales have been about 25% of total U.S. sales in this period. The bright spot for thermoset resins in these three years of declining auto sales is that car makers have increased their use of plastics per car steadily. The largest gainer may be unsaturated polyester, which will go into increasing numbers of exterior body parts in efforts to reduce vehicle weight and improve gas mileage. Epoxy coatings could find increased use to avert corrosion as car makers try to attract buyers with improved warranties. Phenolics could lose some under-the-hood applications to thermoplastic polyesters.

For the future, use of thermosetting resins in autos could rise if more foreign auto makers decide to begin production in the U.S. But there is a competing trend as U.S. car manufacturers make agreements with Japanese producers to import 300,000 to 400,000 per year of subcompact cars that have been designed and built overseas, beginning in 1984. Auto imports, whether by U.S. or foreign companies, represent sales lost by U.S. thermoset resin producers.

In construction, another big thermoset resin outlet, housing starts fell 14% in 1979 to 1.75 million, followed by further losses of 25% in 1980 to 1.31 million and 16% in 1981 to 1.10 million. Though the prime interest rate is down, fixed-rate mortgages are still above 17%, which may keep building of single-family dwellings depressed. Housing starts have hovered at an annual rate of 1.1 million this year because of building starts of federally subsidized housing. □

C&EN converts, publishes phenolic sales data

In January 1981, the Society of the Plastics Industry Committee on Resin Statistics began reporting phenolic resin production and sales and captive use on a gross weight basis, which includes solvents. This change can cause confusion in following the continuity of fluctuations in these resins during a critical economic period. A simple conversion factor is unavailable, because phenolic resin products range from 42% resin content in insulation compounds to 100% for many friction materials, and because sales of various products have changed at different rates.

Based on consultation with industry experts, C&EN has estimated conversion factors for individual product types and applied these factors to SPI data to calculate sales and captive use on an actual resin basis for the six quarters since the reporting change. Because SPI always has reported molding compounds on a gross weight basis, including fillers, C&EN has used these figures without change for sales and captive use. To estimate production, C&EN has followed its own format since the key thermosets series began by subtracting an estimate for molding compound fillers. Conversion factors are thought to be accurate to two significant figures, so sales volumes may be accurate only to the nearest 100,000 lb. Nevertheless, C&EN has retained all figures in case these are of interest.

With the availability of consistent sales data, C&EN has resumed publication of running 12-month growth rates for phenolic resins. This curve shows that rate of sales decline bottomed out in February 1981, began a weak rally that peaked in August 1981, and resumed an accelerated fall that continues to the present time.

Phenolic sales fell 15% in 1981, and seem headed for further losses this year

Thousands of lb[a]	1981 1st qtr	1981 2nd qtr	1981 3rd qtr	1981 4th qtr	1981 Total	1982 1st qtr	1982 2 qtr
Molding compounds[b]	71,162	68,081	59,073	50,581	248,897	48,940	46,539
Bonding & adhesive resins	249,340	256,886	250,809	215,447	972,482	201,332	216,698
Laminates	24,183	21,987	20,298	17,959	84,427	20,236	20,914
Coated, bonded abrasives	5,596	6,845	6,419	5,881	24,741	5,738	4,505
Friction materials	7,926	7,022	7,594	6,908	29,450	6,697	6,958
Insulation materials	35,693	37,226	42,283	36,722	151,924	33,113	33,828
Foundry resins	15,259	13,677	13,066	13,800	55,802	12,399	11,036
Plywood	121,158	132,071	123,837	100,408	477,474	95,718	108,389
Fibrous, granulated wood	25,951	26,283	25,068	19,060	96,362	15,049	19,419
Rubber	3,221	3,536	3,943	3,514	14,214	3,509	3,354
Other	10,353	8,239	8,301	11,195	38,088	9,233	8,295
Protective coatings	5,650	5,743	4,945	4,777	21,115	4,081	3,312
Other[c]	7,780	7,392	7,477	4,264	26,913	3,666	3,894
Total U.S. sales and use	**333,932**	**338,102**	**322,304**	**275,069**	**1,269,407**	**258,019**	**270,443**
Exports	5,152	6,227	4,475	4,507	20,361	4,526	4,286
TOTAL	**339,084**	**344,329**	**326,779**	**279,576**	**1,289,768**	**262,545**	**274,729**

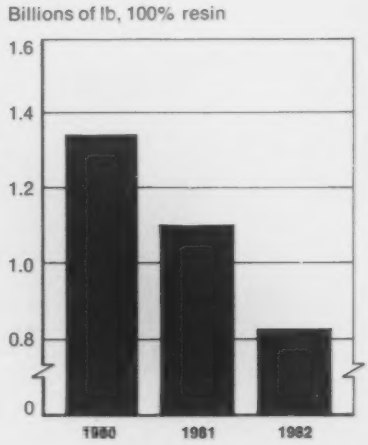
a Sales and captive use, 100% resin basis. b Reported on a gross weight basis in keeping with SPI tradition; molding compounds average 40% resin. c Includes nonadhesive uses in rubber production. **Sources:** Society of the Plastics Industry Committee on Resin Statistics as compiled by Ernst & Whinney, industry estimates

Key Polymers

Phenolics

- ***Markets plummeting***
- ***Real prices steady***
- ***Capacity excessive***

PRODUCTION



HOW MADE

Condensation of phenol and formaldehyde. One-stage resoles cured by heating; two-stage novolacs cured by heating with hexamethylenetetramine

MAJOR USES

Plywood 43%, insulation 14%, molding compounds 9%, fibrous and granulated wood 9%, laminates 8%, foundry core binders 5%

FOREIGN TRADE

Exports—2% of total sales, imports—negligible

PRICES

45 cents per lb, average, 100% resin basis

VALUE

$370 million for production, 1982

The recession has been crushing for phenolic resins, the worst off of major thermosets. Sales for 1982 will be down an estimated 44% from the peak year in 1979.

The continuing U.S. economic malaise is pushing phenolics sales in 1982 down 25% from 1981 to 970 million lb (actual resin). Total 1981 sales were 2.38 billion lb (gross weight) in 1981, according to a new reporting method by the Society of the Plastics Industry's Committee on Resin Statistics, whose statistics are compiled by accountants Ernst & Whinney. C&EN estimates that this represented 1.29 billion lb of actual resin, in terms of SPI's earlier mode of reporting.

Phenolics began to stumble after June 1979 as high interest and inflation rates crimped auto sales, construction, and general manufacturing. That month, running sales were increasing more than 15% per year. An ensuing slide continued until March 1981, when sales were falling at almost 14%. A following lesser rate of loss lasted only until August 1981, when it reached 5%. By June 1982, sales were falling at an even worse 21% yearly, with no letup in the accelerated pace. Phenolic resin sales in the 12-month period ended in June 1982 were 1.15 billion lb of actual resin, the lowest sales level in six years.

Chronically depressed sales have provoked no large-scale defections among resin producers, though a number of firms reportedly are reconsidering their position in the industry. A few small producers for captive use are said to have shut down permanently. Phenolics capacity thus remains excessive, according to industry observers, though it is impossible to estimate capacity even roughly. This is because of a large though unknown number of small producers.

About 87% of phenolics are used for adhesive and bonding applications in durable goods production, which is very susceptible to economic cycles. For example, plywood took perhaps 480 million lb of actual resin in 1981 but may use only 380 million lb this year. For laminates, the corresponding data are 85 million lb last year and perhaps only 77 million lb in 1982. In general manufacturing, including autos, 55 million lb of phenolics was used as foundry core binder for metal casting in 1981. This use may fall to 45 million lb in 1982. Fibrous and granulated wood, used mostly for furniture, took 96 million lb of phenolics last year but may need only 65 million lb in 1982. Insulation materials, such as binder for glass fiber thermal insulation, amounted to 152 million lb in 1981 and may reach only 140 million lb this year.

Insulation may be one bright spot after the end of the current hard times. Predicasts, a Cleveland-based marketing consultant firm, estimates that phenolic foam insulation boardstock sales may amount to more than 70 million lb in 1985 and 110 million lb in 1990. A few firms have begun to produce this 2 to 3 lb-per-cu-ft foam in the U.S. Raw materials costs are about 30 to 40% less than for the competing polystyrene and polyurethane foams it would chiefly replace. Insulating efficiencies are almost as great. Flame-spread rates and smoke densities for burning phenolic foam are said to be inherently less than for other plastic insulation foams, which must be formulated with fire-retardant chemicals to reach these levels. Uses are expected to be in roofing and in walls of new buildings, rather than reinsulating walls of existing buildings.

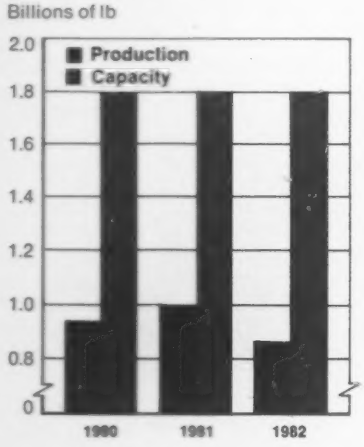
Molding compounds, another large outlet for phenolics, used 100 million lb of resin in 1981 to make 240 million lb of compounds. This application may take only 70 million lb of resin this year for 170 million lb of compound.

Though the next 12 months do not seem a promising time for new phenolic resin plants, new technology has been developed for production of free-flowing, uniformly colored and sized, granular resin. For example, Union Carbide has a suspension polymerization process for license that makes resin suitable for molding compounds, insulation binders and foam, foundry core binders, friction and abrasive materials, and waferboard. The process involves addition of a minute amount of a substance such as gum arabic to reactants to form a protective colloid. The colloidal suspension provides a limited number of nuclei around which polymerization can occur. The process avoids the dehydration, melting, pouring, solidifying, crushing, and grinding steps of conventional processes.

Polyesters

- ***Markets falling off***
- ***Prices depressed***
- ***Capacity ample***

PRODUCTION/CAPACITY



HOW MADE

Mainly polyesterification of maleic and phthalic anhydrides with propylene glycol

MAJOR USES

Construction 31%, marine 17%, castings 12%, transportation 9%

FOREIGN TRADE

Exports—1% of total sales, imports—negligible

PRICES

60 cents per lb, average

VALUE

$520 million for production, 1982

Polyester's relative luck among thermosets in 1981 has run out in 1982. U.S. unsaturated polyester producers managed to finish 1981 with sales and captive use of 977 million lb of resin—no record, but still a 3% gain over the previous year. The renewed strength in resin markets that produced this gain already had begun to ebb in August 1981, and by July 1982 sales were falling at a 9% annual rate. The economic climate in end-use durable goods probably will worsen, and 1982 polyester sales may amount to just 870 million lb, the lowest level in six years.

It's these big-ticket end-use durable goods that can get polyester into trouble. For example, polyesters are buoyed up in good times and weighed down in bad by heavy involvement in boats and other marine uses. This market, which takes 17% of resin sales, represents discretionary spending for consumers, and so is very vulnerable to the present unemployment rate of 9.8%. Unlike automotive and construction areas, marine uses have been penetrated to saturation by these resins, so there is no cushion of increased market share to go for in times of lower boat sales. Moreover, marine parts average 65% resin, compared with only 35% in some construction laminates, so falling boat sales have a heightened impact on polyester volume. Marine sales accounted for 169 million lb of polyester in 1981, little changed from 1980, but 1982 sales could sink to 150 million lb.

Construction, another durables area, is the biggest unsaturated polyester market. Construction use of 301 million lb in 1981 was 31% of all polyester sales and rose 6% from 1980. However, for 1982, polyester sales in commercial, industrial, and housing construction might fall 14% to 260 million lb in 1982.

The transportation market is relatively small for polyesters and currently depressed, but this area offers promise for increased penetration. Auto trunk lids, hoods, and exterior body parts all are candidates. Transportation uses were up 12% in 1981 to 84 million lb, and outlets in autos, trucks, and buses spurted 18% to 65 million lb. But these gains could be wiped out in 1982 as the transportation market subsides 12% to 1980's level of 75 million lb.

Among uses for nonreinforced polyester, castings for such items as furniture and imitation marble for vanities sank 16% in 1981 to 119 million lb. The continuing poor outlook for durable goods could cause a further fall of 3% to 115 million lb in 1982.

Capacity is hard to estimate for unsaturated polyesters, so it is difficult to tell if there have been permanent reductions in the recent producer shuffle. There have been plant shutdowns, and some firms have sold all or part of their operations to other polyester producers. The same vessels used for unsaturated polyester production are convertible to make products such as alkyds for coatings, however. Industry observers tell C&EN that net polyester capacity has remained flat at about 1.8 billion lb for the past three years. To illustrate differences of opinion on this subject, two marketing analysis sources, SRI International and Predicasts, estimated 1980 capacity in separate studies at 1.7 billion lb and 2.1 billion lb, respectively.

Average price remains 60 cents per lb this year, with downward forces from increased competition matched by the opposite pull from some rising raw materials costs. Production of 100 lb of general-purpose polyester takes 43 lb of phthalic anhydride, 19 lb of maleic anhydride, and 38 lb of propylene glycol. Formulators add about 70 lb of styrene to this for cross-linking.

Polyester formulators are trying to hold the price line while still meeting customer needs by increasing the amount of less costly fillers and by foaming the polyester. One promising chemical blowing agent for thermosetting polyester foam is a sulfonylhydrazide, which is oxidized to nitrogen gas by excess peroxide initiator in the formulation. These efforts will tend to reduce the weight of actual resin in parts.

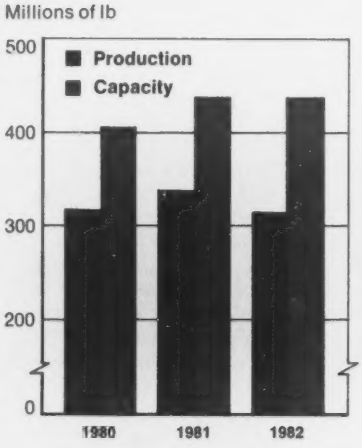
On the safety front, quiet concern is continuing about exposure of polyester fabricating workers to styrene vapors emitted by compounds. The Occupational Safety & Health Administration is staying with its exposure limit of 100 ppm in plant atmospheres, but is mulling a lower level. Industry has studies in progress seeking to demonstrate that a reduction to 50 ppm would produce no additional health benefits.

Key Polymers

Epoxies

- ***Prices up steadily***
- ***Demand soft***
- ***Capacity to expand***

PRODUCTION/CAPACITY



HOW MADE

Reaction of bisphenol A with epichlorohydrin followed by cross-linking with hardeners

MAJOR END USES

Coatings 47%, laminates and composites 22%, casting and molding 9%, flooring 7%, adhesives 6%

FOREIGN TRADE

Exports—12% of total sales, imports—negligible

PRICES

$1.25 per lb, average

VALUE

$317 million for total sales, 1982

The wide base of applications and high performance of epoxies make them more resistant to recession than other thermosets; but they are not immune, producers are learning once again this year as epoxy sales fall with other lagging sectors in the economy.

In 1981, total sales of epoxy resins were 332 million lb, 4.2% more than in 1980, helped along by a hefty increase in exports. Total 1982 sales may be only 310 million lb, however, a 7% drop, even in the face of continued strong exports.

Though calendar years are convenient benchmarks, 12-month running growth rates may better show the backing-and-filling pattern of epoxy sales in the past three years. After a long period of comfortable growth at about 13% per year in the late 1970s, epoxies began succumbing to recession in mid-1979. They reached their first bottom in October 1980, when sales were dropping at an annual rate of almost 7%. A temporary upturn stemmed losses for the year to 4% from 1979 levels, which peaked in October 1981 with an annual growth rate of 8.4%. Renewed sales falloffs limited 1981 sales gains to 4.2% over 1980. This new downturn produced annual sales loss rates of 3.3% by June 1982 and has not bottomed out yet. The end result of all the responses to the economy is that U.S. producers sold 320 million lb of epoxy resins in the 12 months ended June 1982—the same level as in mid-1979.

That the damage is not so bad as it could have been owes in part to a healthy export trade, which is growing not only in amount but as a proportion of total sales. The 31 million lb exported in 1979 was 10% of total sales and grew steadily to 41 million lb in 1981 for almost 12.5% of total sales. Exports for the first half of 1982 again are up sharply to an annual rate of 48 million lb. These high export rates may be due to one producer's decision that continuing advantages in raw materials prices justify concentrating its worldwide epoxy capacity in this country.

Capacity for basic liquid epoxy resin to support these total sales levels will remain adequate at 435 million lb per year among the three producers, Shell Chemical, Dow Chemical, and Ciba-Geigy, until mid-1984. At that time, Ciba-Geigy will bring on 100 million lb of capacity for this resin at McIntosh, Ala., and shut down 60 million lb at Toms River, N.J., for a net industry increase to 475 million lb.

The relatively healthy state of the epoxy business has enabled producers to increase prices steadily. The average price for unmodified resin was $1.05 per lb in 1980, according to the International Trade Commission, and may hit $1.20 per lb later this year. Resins subjected to some kind of advancement averaged $1.27 per lb in 1980, and may reach $1.45 per lb this year.

The largest outlet for epoxy resins is coatings, whose 137 million lb in 1981 was 47% of the U.S. market. Coatings applications may fall at least 12% to below 120 million lb in 1982. Uses for such coatings include industrial maintenance, marine parts, automobile undercoats, interiors of cans, and powder coating of appliances and outdoor metal furniture.

The second largest market is laminates and composites for such uses as electrical parts and electronic circuit boards. The 66 million lb that went for composites and laminates in 1981 amounted to 23% of U.S. sales. This amount may decline 9% to 60 million lb this year.

Epoxies for adhesives are divided between mature, slow-growing markets for general manufacturing and consumer repair kits and faster growing applications in specialty industries like aerospace. The 17.6 million lb used for bonding and adhesives in 1981 was 6% of sales, but only 16.5 million lb may be sold for these uses in 1982, down 6% from last year.

Commercial flooring accounted for 20.5 million lb of epoxy resins in 1981, or 7% of U.S. sales. Declines in construction and investment in new plants may bring these sales down 10% to 18.5 million lb this year.

Another outlet for epoxy resins is making molds for production of parts from other plastics in the auto and aerospace industries. These tooling resins, almost 30 million lb or 10% of sales last year, may amount to 25 million lb in 1982. This would be the greatest annual drop—17%—of the major epoxy uses.